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Enhancing Student Learning of Enterprise Integration through ERP Simulation Game

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ENHANCING STUDENT LEARNING OF ENTERPRISE INTEGRATION THROUGH ERP BUSINESS SIMLATION GAME

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ABSTRACT

Difficulty of teaching concepts of business processes and business process orientation using traditional teaching and learning methods is well recognized in the literature. This paper reports on the effectiveness of an initiative that employs 'ERPSim', an ERP Business simulation game that uses a simulated and complex business environment supported by industry standard software, SAP. Using this simulation game, this initiative aims to teach process concepts and enterprise integration to students who have no practical experience and limited understanding of business operations and information systems in an Australian Business school. Analysis of the data indicates the success of this initiative, despite some operational problems for the academics and cognitive challenges to some students. The study particularly reports improvement in the understanding of the concepts of integration and business processes, the primary objective of introducing this game. Based on the feedback from participants and the experience of academics in administering the ERP Sim game, this study offers some suggestions for further improvement.

Keywords: Simulation, pedagogy, ERP, business processes, integration

I. INTRODUCTION

Understanding and managing business processes and enterprise integration are key graduate requirements today. As business process management is an emerging area currently lead by practitioners rather than academics, traditional teaching and learning resources are limited. In an environment where majority of post graduate students have limited understanding of business operations and lack any practical experience, it is difficult to teach these concepts using

traditional lecture based methods. In order to help students understand the wider business process context that underpins integration of information, strategy, information systems, people and processes, there is a need for introducing new innovative teaching and learning activities. ERP simulation game is one such initiative that exposes to students to an authentic learning experience in a simulated, yet complex business environment and expected to offer an exciting and stimulated learning environment. By exposing students who typically specialize in one discipline and have limited or no understanding of business operations and practical experience to industry-standard ERP software, this game is expected to impart necessary business process orientation and enterprise integration concepts to business students. This paper reports on the effectiveness of that initiative and discusses the challenges and opportunities. It will first present a review of literature on simulation in business courses and background to the ERP simulation game. It will then explain the initiative undertaken by an Australian university and the methodology adopted in conducting this evaluation research. It will present the findings of this study and discuss implications and challenges.

II. LITERATURE REVIEW

Faced by continued criticism of employers and industry about the relevance of business education, business schools have to deal with this challenge. In addition, increasing class sizes, limited availability of resources, higher expectations and diversity of students [Boud et al., 2000; Reynolds, 2000] are placing demands on higher education to explore new pedagogies [O'Leary, 2005]. In particular, business schools are facing dual challenges - making their courses relevant by incorporating industry-relevant skills and knowledge, and designing and implementing innovative and effective learning methods and pedagogy.

The pedagogical model of business education developed at the beginning of 20th century that was embedded in a functional structure is still followed in 21st

century and continued to produce graduates with specialist technical skills and knowledge in accounting, marketing, logistics or human resources. Several reviews of business education in the past have consistently pointed out the importance and lack of business process orientation and questioned the relevance of business curricula in the current globalized and dynamic business environment [Cecez-Kecmanovic et al, 2002; Ethie, 2002; Trites, 2004]. Many employer representatives and professional organizations such as Business Council of Australia, Australian Computer Society, Australian Management Institute etc, have advocated incorporating 'employability' skills such as business process orientation and generic graduate attributes such as communication, leadership and group work in the curricula [Curtis and McKenzie, 2001]. As identified in a recent study by University of Melbourne researchers, the business process analysis skills rather than the ability to write technology programs are needed to support large scale technology-enabled business process transformation projects being undertaken by numerous Australian companies [AFR 2008].

In response to this continued criticism, business schools have been implementing several pedagogical strategies such as capstone project, integrated case studies, team teaching, information technologies/tools [Seethamraju, 2007] and developed learning environments such as workplace learning, experiential learning, experimental learning, collaborative learning, problem-based learning, blended learning and simulation games [Van Baalen & Moratis, 2001]. The need to focus on learning outcomes that incorporate industry-relevant skills is forcing business schools to develop innovative, new and effective teaching and learning methods and pedagogy and simulation is one of them.

Simulation has long been a powerful tool and used by corporations, management consulting firms and business schools [Faria, 1998; Martin, 2004]. In fact, about 32% of the business school in USA use simulation games [Faria and Wellington, 2004]. Their potential to provide real-world business environment

to participants in class-room environment has made them one of the most preferred methods of teaching and learning [Faria, 1998; Anderson, 2005]. Simulations offer an engaging and innovative learning experience to students and deliver positive learning results. They offer the advantages of approximating the characteristics and dynamics of complex and realistic contexts, without the effects that manifest themselves in real-life contexts (such as bankruptcies, costs, responsibilities etc.) [Moratis et al., 2006]. Simulations allow students to 'stop the world' and 'step outside' of the simulated process to review, reflect and understand better [Parush et al., 2002]. In addition to allowing the repetition, replication, practice and development of skills, simulation games offer deeper insight and understanding of the complex business environments. Simulation facilitates integration of learning experiences, and improvement of other skills such as communication, group work and learning to learn [De Caluwe et al., 2001]. The frame of reference and environment provided in a simulated business setting gives student some of the experience they need in their future roles in business organizations [Licari and Ovedovitz, 2002]. The use of simulation facilitates student learning [Wenzler and Charlier, 1999] and increased understanding [Klein, 1984] and provide valuable real world experiences for students with minimal expense in terms of disruption, employer liaison and monetary costs [Griffin and Williams, 1964]. Simulations lead to a deeper understanding, offer insights into dynamic dependencies, reduce complexity and offer a basis for sound discussions between students and teachers (Westernberger 1999). The competitive element and focus on outputs or outcomes in business simulation games will particularly help in realizing 'inter-disciplinarity' [Moratis et al., 2006], an essential skill required for business graduates today.

Business simulation games are used to teach various subjects such as ethics [Wolfe and Fritsche, 1998], international business communication [Doyle and Brown, 2000], integration of business knowledge [Stephen et al., 2002], differences in culture [Chatman and Barsade, 1995], information systems development [Martin, 2000], knowledge management education [Chua, 2005],

marketing [Fritzsche and Burns, 2001] and finance. They are also used in capstone strategy courses as a tool to integrate the concepts and knowledge acquired through business curriculum and to provide a simulated, hands-on business experience [Anderson et al., 2005].

Simulations helped US business school students in developing competencies to solve problems, making forecasts in uncertain environments [Teach, 1993; Faria and Wellington, 2004]. Simulation also contributed to learning Irrespective of their knowledge level prior to the simulation [Wolfe & Chanin, 1993]. Business simulations have the ability to create 'micro worlds' in which students can gain a better understanding of individual effects of decisions as well as the interactive effects of environment and competition on a company [Romme, 2003].

In addition to providing 'real-world' experiences for students, the *educational* benefits of simulations in business education have been supported in the research. They increase interest, involvement and enthusiasm in students through a competitive element that approaches interest shown in real life experiences [Anderson, 2005]. They also lead to a deeper understanding, offer insight into dynamic dependencies, reduce complexity and provide a basis for discussions between students themselves and between students and teachers [Westenberger, 1999]. Simulations have the ability to blend delightful engagement activities with interactive and self-regulated learning [Chua, 2004]. Business management knowledge is not black and white, and 'speckled and shaded with differing patterns' depending on the current situation and the individual perspective [Hall, 1996]. The knowledge of business management, characterized by its relatively ill-structured, interdisciplinary, and complex knowledge domain aims especially for arriving at comprehension [Moratis et al., 2006]. Comprehensive learning methods, rather than apprehension learning methods are better suited to develop understanding and simulations therefore are central in business management learning environment [Moratis et al., 2006].

The use of practical experiences with simulation allows such students to experience something realistic about business processes and assists their knowledge and skill development, ultimately making them of greater value to future employers. Simulations are of further value because they can reduce the complexity of early experiences with business processes, (and hence cognitive load), allowing students to focus on the concept(s) being taught.

III. BACKGROUND & RESEARCH METHODOLOGY

BACKGROUND TO THE STUDY

Using enterprise systems in simulation is expected to facilitate an understanding of business processes for business students and imparts valuable skills to use industry-standard software [Draijer and Schenk, 2004; Leger, 2006]. Simulation helps connect theory and practice and fosters students' understanding of the power of information and software tools in modern organization. With most of the business students specializing in only one discipline such as accounting, marketing, human resources or logistics, cross-functional nature of business processes is very hard to grasp and very difficult to teach. In addition, when majority of students enrolled in this course have no practical experience and limited understanding of business operations and processes, it is very difficult to demonstrate the links between processes, information systems, business strategy and decision making using traditional teaching methods. Moreover, inadequate interest among business students about the information systems courses in the business school and the determination by the School to embed process orientation, one of the key employability skills more deeply into the business information systems course are strong reasons for introducing this game. Even though the school has previous successful experience of teaching SAP, industry standard ERP software in another elective course, the challenge is to teach the concepts of business processes, integration and information systems in a business context with business focus rather, without resulting in undue focus on IT skills.

ERP SIM GAME

The ERPSim - a simulation game, originally designed by a team of academics in HEC Montreal (a leading Canadian University) and implemented by more than 10 business schools in North America is a turn-based game. Students are expected to work in collaborative teams of five students with each team operating a firm. Each team will interact with customers and suppliers by sending and receiving orders, delivering their products, determining pricing strategy, cash flows, credit management, using business intelligence and reporting in successive quarters and completing cash-to-cash cycle. The game relies on the information, transactions and reports provided by SAP, an industry-standard enterprise resource planning (ERP) system.

Enterprise resource planning (ERP) system is a comprehensive transaction management system that delivers a majority of business transactions in all areas of business including procurement, production, human resources, pay roll, accounting, sales and service. Using a central database and single user interface, it facilitates integration of data, processes, organization and people across the enterprise. With its focus on business processes and information flows across various functions, ERP system acts as an underlying link between various functional disciplines. This has the potential to provide students with experience of business processes, even though they may not have entered a business environment. In addition, students will develop skills and ability to carry out routine business transactions, extract relevant transactional information recorded during the business process execution, to analyze the firm's profitability and to update its strategy and decisions accordingly. In addition, the team dynamics while playing the game as a senior management team in a typical company and their potential affect on the learning outcomes are important issues that require further investigation. Even though computer based simulation games have become a popular pedagogical tools, research is only beginning to consider how these simulation games impact learning outcomes [Anderson et al., 2005]. In a recent article in Harvard Business Review, Edmondson (2008) advocates 'execution-as-learning' rather than mere flawless execution – the 'efficient, timely,

consistent production and delivery of goods and services, as the path to customer satisfaction and financial results. Providing process guidelines, tools that enable employees to collaborate on real time, collection of process data and institutionalization of disciplined reflection are the key steps in achieving success (Edmondson 2008). ERP Simulation game, with its focus on familiarizing business processes to students with no previous experience and/or knowledge, offers SAP software tools for capturing and analyzing business transactional data and for collaborating online in real-time. In a simulated yet complex business environment closest to the real-world, 'ERPsim' game offers students the opportunity to reflect, to test and find out what works and what doesn't, and gain insight into the business processes, information systems, business strategy, managerial decision making, analytics and team dynamics.

LEARNING OBJECTIVES & GAME DESIGN

Some of the main learning objectives of introducing this ERP simulation game in this course are i) to make students understand the wider business process context that underpins integration of information, strategy, information systems, people and processes, ii) To develop business process orientation and understanding of various business operations and enterprise integration, iii) to provide business students with an authentic and exciting student-centered learning experience that is integrative and motivates them to learn. In addition, the aim is to offer students a quality information-rich environment that encourages peer interaction, collaborative student learning and effective skill development and importantly a sense of enjoyment of learning.

The game is scheduled for two sessions of 3 hours each in two weeks. There are eight teams in the class with each team having 5 to 6 students (a total of 52 students in class). This game can be played differently using different sequences and by choosing to automate some processes. Employing adult learning principles, the program is designed to take students from 'known to unknown' and focus first on the sales process. The game organizers (academics) will first run all the four teams for the first two quarters by carrying out initial

financial transactions automatically and by creating initial stocks of 200,000 units to start the selling process in quarter 3. Thus, in the first week students are exposed to the cash-to-cash business process cycle through explanation and demonstration of basic SAP transactions and by playing the game for 4 quarters. In groups of five students, each team is required to make business decision on pricing based on real-time business intelligence and transactional data obtained from SAP.

Students are given a one page 'job-aid' that explains the transactions they are required to carry out and the reports they need to check for making pricing decision in the first week with the objective of maximizing their profit. Teams will play the game for one quarter in which they vary the price and understand the price and demand sensitivity of the market and learn to read various reports. Typically by the time third quarter is completed, teams will face a stock out situation having sold all their stocks. At this point, a pause is given and students are given an explanation and demonstration of the various steps in the production process. In the first week, teams are changing the pricing and looking at the sales data. The objective in this initial stage is to maximize sales revenue. At the end of the third quarter, simulator publishes overall financial performance of all the companies. Teams are then asked to produce the stocks for the fourth quarter. They will then do the demand forecasting, carry out MRP run, convert purchase requisitions into purchase orders, and convert planned orders into confirmed production orders. With appropriate time lags built in the system, and considering the production schedules proposed by the teams and capacities, finished goods stock is built for selling in the fourth quarter. Thus in the first week, the objective was to familiarize students with the SAP transactions and reports and develop some ability to make a pricing and production decisions based on the analysis of information presented by SAP reports and familiarize themselves with the steps in the production process. Continuous coaching is made available to assist the teams in carrying out transactions and to deal with the challenges of technology if any.

In the second week, initial financing of the companies are carried out by the administrators and all teams start with initial cash to buy raw materials for production and to incur other direct and indirect expenses. In addition, they have the capability to modify the bill of materials and develop niche markets for their companies. Eight teams have started with the planning and production process. The game continued for four full quarters of 25 days each with students continuously evaluating their strategy after every quarter. At the end of every quarter, quarterly financial statements and performance results of each team are displayed to students. During this process, teams will be continuously checking their stocks, average price of the products in the market place, production schedules, costing and other reports. A debriefing session is conducted at the end of the session wherein students are asked to discuss the decisions they have made and give reasons, the consequences and the role of information and integrated nature of business to the class.

DATA COLLECTION

Feedback was then collected from these students after the experience with the help of a questionnaire designed for this study. The questionnaire consisted of some basic demographic details such as gender, course they are currently enrolled in (IT or business related), whether they have any previous experience or not, and whether they have any previous knowledge/experience of working with SAP. In the second section, students are asked to make a self-assessment of their knowledge on specific dimensions/concepts and the competence gained before and after this game using a 7-point Likert scale (1 = very low, 7 = very high). These statements are developed taking into consideration the objectives of this game, learning outcomes expected, and the specific concepts such as business process, business terminology, integration, decision making, information and enterprise systems; and the assessment of their ability to execute SAP transactions and reports before and after the game. In addition, participants are asked to rate their general attitude towards the game in terms of its generic learning value, understanding of the significance of the enterprise

integration, information flows, process orientation, decision support capability and collaboration and communication among the team members.

IV ANALYSIS, DISCUSSION AND IMPLICATIONS

DEMOGRAPHICS

Out of the 44 valid responses received (from 55 total participants in the course), 60% of the respondents to the survey are male and 40% were female. Analysis revealed that 42% of the students are local students and the remaining 58% of the students are international students coming from different countries such as China, Indonesia, India, Japan, Thailand and Scandinavian countries. A brief summary of the demographics are shown in table 1 below.

Table 1: Demographics of respondents

No.	Characteristic	Value
1	Number of valid responses	44
2	Percentage of male respondents	60%
3	Percentage of Local respondents	42%
4	Percentage of respondents coming from School of Information Technology/computer science courses	41%
5	Percentage of respondents studying Business courses in business school	59%
6	Percentage of respondents with previous experience	65%
7	Percentage of respondents currently employed	40%
8	Percentage of respondents below the age of 30 years	65%
9	Percentage of respondents reporting some previous SAP knowledge	21%

Even though this subject was offered by the Business school, 41% of the students enrolled in this course came from the School of Information technology/computer science. Business experience and previous knowledge/understanding of SAP are potentially independent variables influencing the knowledge they already have before enrolling in this course. Therefore, data on the previous work experience was collected. On the employment indicator, data revealed that 65% of the respondents have previous work experience and 40% are currently employed. Age was not considered a

major differentiating variable in this study, since 65% of the respondents were below the age of 30 years. Though 21% of the respondents have reported some previous knowledge of SAP, just 1% of the total students ever reportedly had any serious exposure to SAP system. It appears the remaining respondents (from 21% that claimed to possess previous knowledge of SAP) have just reported seeing SAP screens before in their organizations and no real experience of working with transactions. That way, the participant population is fairly uniform with practically now previous knowledge of SAP. The effect of previous knowledge and experience of working with SAP on their ability to participate in the 'ERPsim' game and achieve learning outcomes can therefore be considered negligible and the potential gain in their knowledge can be attributed to the simulation game.

CONSTRUCTS – DEFINITIONS, RELIABILITY AND VALIDITY

The definitions of the three constructs used in further analysis are given below. They refer to the knowledge and ability participants are expected to gain by participating in this ERP Sim game.

Table 2: Definition of the Knowledge/ability constructs/dimensions

Knowledge dimensions/ constructs	No. of items	Definition
Business process knowledge	5	Knowledge of the basic business terminology that relate to various functions (sales, production, procurement & accounting), concepts of business processes (business process, integration, ERP systems) and their cross-functional relationships
Transactional knowledge & ability	3	Technical software ability to carry out basic SAP transactions such as modification of the Bill of Materials, sales demand forecasting, MRP run, conversion of purchase requisitions and planned orders and other related transactions in Sales, Production and Procurement applications required in the game
Reporting knowledge & ability	6	Ability to produce SAP standard reports for production, procurement, financial and sales applications, analyze the information and use it in decision making

In order to test the psychometric properties of the questionnaire, a reliability analysis was carried out. All the 14 items in the questionnaire were grouped into three constructs namely – Business process knowledge, Transactional knowledge & ability and Reporting knowledge & ability. The total scores for each of the constructs were computed as a sum of the values and used for reliability analysis. Similarly the inter-item correlations were also computed in order to analyze the convergent and discriminant validity of the items in the instrument. The Cronbach alpha for all the three constructs was observed to be more than 0.86. In general, an internal consistency (Cronbach alpha values) of less than 0.6 is regarded poor while above 0.70 is acceptable [Cavana et al., 2001].

All the correlations (Pearson's r) among the factors and the overall construct (summative score of the instrument) were observed to be significant at $p<0.01$ level (2-tailed). The reliability scores for each of the factors and the overall instrument were also good and more than 0.84. The lowest correlation was between 'Reporting knowledge & ability' and 'business process knowledge' constructs (0.45) and highest between 'Transactional knowledge & ability' and 'business process knowledge' constructs (0.87). Similarly all the three constructs correlated significantly with the overall index of 'perceived knowledge gained' and the values ranged from 0.61 to 0.85. Examination of the inter-item correlations shows values ranging from 0.51 to 0.94. The analysis thus confirmed the sound psychometric properties of the data collection instrument in terms of its validity and reliability.

PERCEIVED GAIN IN KNOWLEDGE & ABILITY

The difference between the perceived knowledge before participating in this game and after were computed and used for analysis in this study. This difference was considered a measure of the level of knowledge and skills gained by the students as perceived by them from the game. In addition, total indices for

various hypothesized constructs were computed using responses for individual items as shown in the following table.

Table 3. Perceived gain in knowledge and ability – t test values

Variable – Perceived gain in the knowledge and/or ability	t-value	Signifi-cance	Std. Dev.	Mean
Knowledge of BP Concepts	7.809	0.000	1.147	1.53
Knowledge of business terminology in the Production process	8.994	0.000	1.146	1.73
Knowledge of business terminology in the Procurement process	7.553	0.000	1.119	1.42
Knowledge of business terminology in the Sales process	4.887	0.000	1.314	1.08
Knowledge of business terminology in Financial Accounting process	5.086	0.000	1.163	1.02
Knowledge of the concepts of ERP systems	8.802	0.000	1.152	1.71
Ability to process Operational Transactions in Planning process	9.858	0.000	1.132	1.98
Ability to process Operational Transactions in Procurement process	8.799	0.000	1.172	1.84
Ability to process Operational Transactions in Production process	8.246	0.000	1.435	2.11
Ability to use reporting Functionality in Procurement and Production process	7.382	0.000	1.717	2.14
Ability to use reporting Functionality in Sales process	8.649	0.000	1.409	2.19
Ability to use reporting Functionality in Accounting	6.182	0.000	1.422	1.60
Ability to produce reports from the ERP system	8.749	0.000	1.098	1.65
Ability to analyze information and reports produced	10.698	0.000	0.978	1.82
Business concepts – terminology & process (5 variables)	9.85	0.000	5.52	8.20
Ability to process transactions (3 variables)	11.9	0.000	3.27	5.86
Ability to produce and analyze reports (6 variables)	9.46	0.000	5.83	8.32
Overall perceived gain (14 variables)	12.50	0.000	11.88	22.58

Considering that the maximum possible gain in the knowledge level was 4 (1 before enrolling in this unit, and 5 after completion of this unit), some improvement in the knowledge and skills was observed across various

dimensions. Paired samples t-tests comparing the values 'before' and 'after' as reported by the participants showed that the there is a significant gain in the knowledge and ability across various variables as shown in the table 3. Analysis of the data as shown in table 3 suggests that the game has achieved its objectives of imparting the conceptual knowledge of business processes as well as basic software skills. Particularly, there is an improvement in the understanding of the concepts of integration and business processes, the primary objective of introducing this game.

Further examination shows a larger improvement in the ability of participants to see and analyze reports in procurement, production and sales processes than other aspects. Similarly, they have reported higher ability in carrying out operational transactions in production, procurement and sales processes than in accounting process. This is expected, as participants were not required to perform any accounting transactions other than checking the reports. As mentioned earlier, in the version of the game deployed in this case, a majority of the accounting and sales processes were automated and participants were required to perform basic processes such as Materials requirements planning (MRP) run, conversion of planned orders into production orders and conversion of purchase requisitions into purchase orders. In addition participants are required to study the reports such as stock report, sales report, inventory report and production report.

PEDAGOGICAL EFFECTIVENESS

In addition to their knowledge, students are asked to rate in a scale of 1 (strongly disagree) to 5 (strongly agree), their general attitude towards the simulation game with reference to various aspects. These twelve items deal with the learning value, integration and group working concepts. Participants are asked to rate their perception of the learning value derived from this simulation game – whether learning through simulation game is exciting, interesting and innovative than traditional teaching methods. Similarly, participants are asked to rate whether this simulation game helped them in their understanding and

appreciation of the concepts of integrated information, integrated processes, importance of inter-dependencies between various functions, importance of accurate and current transactional data and information flows across various functions. In addition, students are also asked to rate how this game helped them in understanding the importance of coordination and communication between various functional managers and organization of the tasks while playing the game. A summary of participants' attitude towards the ERP Simulation game is shown in table 4.

Table 4. Attitude towards ERP Simulation game

	Attitude of participants towards the game	Mean	Std. deviation
1	Integrated with the program well (1)	3.79	0.98
2	Learning value compared with traditional lecture based teaching (interesting, exciting & innovative) (3)	4.27	1.01
3	Understanding of significance of integration (information, processes & interdependencies) (3)	3.96	0.97
4	Understanding of the accuracy and currency of information for decision making (1)	3.91	1.12
5	Need for coordination and communication among functional managers (2)	3.97	1.12
6	Understanding info. flows across various functions (1)	3.98	1.14
7	Organising tasks in the game – key to success (1)	4.01	1.19
8	Overall Attitude towards the Simulation Game (12 variables)	48.27	12.01

As shown in the above table, all the variables are rated 'good' (above 3.0) and the overall attitude towards the game is positive (average more than 4.00). Response to individual items, however range from 3.79 (game integrated with the course well) to 4.27 (learning value of the game when compared to traditional lecture based teaching methods). Confirming that the game is pedagogically effective, an overall rating of 4.03 is recorded. The participants thus have not only gained the knowledge but also demonstrated understanding and appreciation of the significance of enterprise integration. The findings suggest that the game has enabled students in appreciating the need for coordination and communication among functional managers or team members and in recognizing

the importance of organizing the tasks among its members. Thus, the importance of working in an integrated environment and business process perspective typically enabled by an ERP system is recognized and appreciated by the participants, reinforcing the pedagogical effectiveness of this game.

In order to see whether there are any significant differences between different groups of participants (classified with reference to various independent variables), two tailed t-tests for two independent samples at 5% significant levels are considered appropriate and employed. Because of its robustness, versatility and its general acceptance in the literature, parametric tests such as t-tests are increasingly used with ordinal data (Hair et al 1998). Results of t-tests showed that there were no significant differences between business/commerce students and non-business students with regard to the perceived gain in knowledge (business process knowledge, transactional ability and reporting/analysis ability), as well as no differences in their knowledge and ability before participating in the game.

Table 5. T-test results – Overall attitude towards game

Construct	Independent variables & significance	Values
Overall attitude towards the ERP Sim game	• Business students (26) • Non-business students (18) • T-value • Significance	53.8 43.1 2.04 0.022*
Overall attitude towards the ERP Sim game	• With previous experience (29) • With no previous experience (15) • T-value • Significance	45.1 53.8 1.96 0.034*

* Significant at $p < 0.05$ level

There, however, some significant differences observed with regard to their attitude towards the game with business students having a more positive view of the game. Business students reported significantly higher learning value from the game, better appreciation of the integration and its significance in business information and processes, higher recognition of the need for coordination,

cooperation and communication among functional managers. Similarly, there are significant differences noticed between the participants with some previous experience and those who did not have any previous experience. Participants with previous experience has reported a higher positive view towards the simulation game and appear to have perceived higher learning value, improved understanding and appreciation of the integration and inter-dependencies and the need for cooperation, communication.

QUALITATIVE FEEDBACK

In order to capture the overall perception on the entire experience, participants were also asked to identify the best and challenging aspects of learning in this game. The quantity and quality of written responses were content analyzed and a summary is presented below. On average, each participant has identified 2.4 points under best aspects of learning in the game and 1.6 points as the challenging aspects. The following table provides a summary of the best aspects of learning as identified by the participants.

Table 6. Best aspects of learning in the game

	Best aspects of learning in this game	Frequency
1	Learning value – stimulating, innovative, dynamic and new way of teaching and learning; beyond text book and traditional teaching methods	28
2	Learning method – interesting, entertaining and easier and quicker way of learning and understanding concepts	22
3	Learn by doing – how business runs its operations, information flows, and decision making	19
4	Team work and decision making skills	16
5	Learning from ‘mistakes’ and by ‘reflection’ and ‘discovery’	12
6	Deep learning (permanent and thorough learning)	10

As shown in the above table, participants appreciated the learning value of the game, listed that as the best aspects of the game. Participants observed that the

game is ‘fun’, stimulating, innovative, dynamic, fun, entertaining, easy, interesting and is quicker way of learning and understanding the concepts.

The challenging aspects of the game as expected relate to the difficulties of working in teams, analysis of information and reports, learning from mistakes, and complexity of the SAP software. Surprisingly, working in teams is identified as the most challenging aspect of this game which requires participants to recognized the inter-dependencies and manage distribution of tasks, coordinating the decisions and transactions and continuously communicating among themselves, typically required in a dynamic business environment and facilitated by an integrated information system. A summary is shown in the table below.

Table 7. Challenging aspects of learning in the game

	Challenging aspects in this game	Frequency
1	Team working – coordination, communication and cooperation	20
2	Analysis – information, reports, transactions	15
3	Learning from mistakes and reflection	12
4	Learning software (transaction codes & screens are challenge)	9
5	Complexity and information overload	8
6	Difficulty in understanding integration when tasks are divided	7

Some of the participants also pointed out the information overload. ERP system produces a large volume of information because of its transactional nature, and requires discerning manager to look for information that is relevant and useful for a particular decision making. Considering the complexity of the SAP software, it is normal for participants who had no previous exposure to the ERP system software to feel the pressure and view this as information overload and too complex. Attempts are made to simplify the system and the processes by explaining the basic concepts and by employing some of the basic adult learning principles such as ‘known to unknown’, ‘small incremental chunks of learning’ and ‘learning by doing’.

SUGGESTIONS AND IMPROVEMENTS

An informal discussion with participants after the game and reflection by the academics administering the game has resulted in the following suggestions for improvement. It is generally felt that some basic knowledge of ERP systems and SAP software before the game would help the participants learn better and add value to the exercise. It is believed that participants, with some basic understanding and familiarization with the SAP software, will be able to concentrate on the business processes, business strategy, analysis of information and decision making rather than getting bogged down with the technical aspects of the software. Even though the introductory session includes some explanation of the basic business processes such as procurement, sales, production and planning, it is generally felt inadequate and an improvement is recommended. Further participants pointed out the inadequacy of the feedback on groups' performance. Even though the financial reports and comparative sales reports are shown at the end of each quarter, no further explanation was offered by the academics on them. With a majority of students not having any previous experience and knowledge on accounting and financial statements, it is generally felt that a further explanation by the academics is necessary to reinforce the conceptual understanding. Some participants also asked for some practice game sessions in order to give them some valuable experience in playing the game and understand the intricacies of various dimensions in the game. A summary of the suggestions and actions for improving the learning value and experience are presented below.

- Introduce SAP to the participants before the game with some basic transactions and concepts
- Provide feedback on groups' performance after the game in two stages
- Formalize the discussion of the mistakes and reflection on issues such as strategy and planning, usage of information and reports, task allocation, transactions and group working

- Allocate some time for practice sessions before the actual game in order to help them understand the intricacies of the game and the simulation.
- Elaborate debriefing session that includes evaluation of the various strategies adopted by the groups, reinforcement of important concepts and take home points

Importantly, participants recognized the 'learning from mistakes', 'reflection', 'discovery', and 'deep learning' as best aspects. This reinforced the value of experimentation and reflection vital to sustainable success as suggested by Edmondson (2008). This ERP Simulation game had made participants recognize the importance of those values. It helped them develop those skills vital for their success in modern organizations. When compared with other simulation games, this ERP Simulation game makes contribution not only to the pedagogy of teaching and learning by its stimulating, fun, entertaining and innovative approach, but also gives the participants an opportunity to work with an industry-standard enterprise resource planning system, SAP. Thus, it gives them an excellent understanding of the business processes, enterprise integration and information systems concepts and a well-sought after software skills that could potentially enhance their employability.

V. CONCLUSIONS

Teaching in emerging disciplines such as business process management and enterprise systems in higher educational institutions and teaching applied concepts such as business processes, process orientation, cross-functional perspective and integration are always challenging. Several business schools throughout the world are using various teaching methods including some other simulation games. While all simulation games offer some exciting and interesting learning environment for students and encourages active learning, this particular approach that incorporates industry-standard ERP software, SAP, has a particular advantage. In addition to a better understanding of the content-based issues, this approach presented opportunities for students to appreciate the inter-

dependencies between various functional disciplines, the value of integrated information and business processes across the enterprise and the need for coordination and communication among functional managers. Importantly, this pedagogical approach as observed in this study, encouraged 'learning by doing' and 'learning by mistakes' and reflection, in a non-threatening way.

This approach exposed students to a complex business environment that is closest to the real-world and yet managed to offer a stimulating and interesting learning experience. The valuable skills and knowledge gained by participants from this game will encourage them to experiment, reflect and learn continuously. It fosters an atmosphere in which trust, flexibility, innovation and empowerment flourish. Even though this paper reports the pedagogical success of this initiative in one university business school in Australia which is an SAP Alliance partner, this study will lead way to several other universities that are attempting to make the learning these complex concepts of process integration and SAP software more interesting. Though it is early days in understanding the effectiveness of these learning models, their potential contribution to the improvements in the teaching and learning pedagogy and the depth of learning in a higher educational environment appear to be significant.

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